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ORIGINAL ARTICLES.

GLAUCOMA AFTER EXTRACTION OF CATARACT.

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The precise conditions which lead to glaucoma after the successful removal of cataract are not yet so well established or understood as to render a further study of these cases unnecessary. The three cases I propose bringing before you present some features I think which are worthy of consideration, and in the matter of treatment I must confess myself still in doubt as to the proper course to be pursued. It is in this direction especially that I shall be glad to hear the views of other ophthalmic surgeons who may have had a wider experience than has fallen to my lot. I shall, without further comment, proceed to give the salient features of these cases.

CASE I. J. M., a rugged Scotchman, æt. 73; left eye uncomplicated, mature cataract, removed early in September, 1883. Ether used as an anæsthetic. The extraction was with iridec-

tomy and peripheral capsulotomy, perfectly smooth, puncture and counter-puncture being about 1 mm. behind clear cornea. In healing the inner angle of wound contained just a small portion of entangled iris, not a prolapse, but just enough to show as a small dark spot beneath the conjunctiva. A slight iritis appeared at the end of first week, but no adhesions resulted. Sixty days after extraction the eye was quiet, and V.=$^{20}/_{L}$ with $+4^{1}/_{2}$, sph., capsule rather dense. Discission done with two needles; moderate reaction, irregular central aperture obtained not quite as large as desired. On April 14, following, a note was made of vision, etc.: $4^{1}/_{2}\bigcirc+28$ cyl. ax. 90° V.= $^{20}/_{XXX}$ and $+3$ sph.$\bigcirc+28$ cyl. ax. 90°; reads J.I. at 10″ fluently. The condition of the eye appeared entirely satisfactory. For several years the eye was used freely, especially in reading, the patient being rather a book-worm. His habits of life were regular and temperate, except that he is unduly addicted to snuff-taking.

About the beginning of the year 1888 he found the vision of the left eye deteriorating. Shortly afterward I examined the eye, and discovered rather deep cupping and an atrophic appearance of the optic nerve, just as in ordinary chronic glaucoma. Tension was decidedly increased, there was the usual limitation of the visual field, and vision reduced to $^{20}/_{LXX}$. In March, 1888, vision was still further reduced to $^{20}/_{CC}$. I then made a free sclerotomy downward, without benefit. In January, 1889, vision was reduced to qualitative perception of light, and the eye had now a distinctly glaucomatous appearance, with symptoms of considerable irritation and still greater tension. The cornea was cloudy; iris and capsule pushed forward, and the lower lid in a condition of entropium.

The right eye was now blind from complete cataract, but otherwise healthy. On January 2[illegible], I removed the cataract from the right, under cocaine. Recovery from the operation was perfectly normal, and the eye is as good to-day as could be desired. The capsule is not opaque and scarcely interferes with vision. The patient, now 81, somewhat ostentatiously declares he can see as well as ever he could in his life. The

left eye has ceased to trouble him, although the lower lid still turns in, and the eye has the typical appearance of glaucoma consummatum. There is practically no anterior chamber, the iris and capsule dimly seen through the cloudy cornea are pushed forward to its posterior surface.

In addition to a general cloudiness of the cornea there are many circumscribed, dense interstitial and vascularized opacities. Inversion of the lid and consequent mechanical irritation of the cornea will doubtless account to some extent for the unusual development of blood vessels in its substance. Another peculiarity is in the scar of the original wound, which now appears as a dense vascularized yellowish white streak, about .5 mm. in width across the upper part of the cornea. That the entropium had nothing to do with the development of the glaucoma is obvious, since the lid only became inverted when the eye was already practically blind.

As far as I could ascertain, there were three factors likely to have been instrumental in lighting up the glaucomatous process. They were, first, the small portion of entangled iris at the inner end of the wound; second, the patient's bookish propensity; third, the thick capsule which, after discission, formed a dense band above, which, to all appearance, lay along that portion of the canal of Schlemm which corresponds to the coloboma. With the band of capsule in this position and the entangled iris, as described, in all probability excessive use of the eye in reading created sufficient irritation to obstruct the circulation of fluids in a considerable extent of Schlemm's canal, thus initiating the glaucomatous process. Should I again meet with a similar chain of circumstances, I would feel inclined to perform the sclerotomy upward with the hope of establishing a filtration scar through the line of obstruction.

CASE II. October 12, 1887. A. D., æt. 73, Scotch by birth. Is a tall, robust looking man for his age, and in good general health. Has been failing in vision for some months, and there is a natural uncomplicated cataract in right eye. Left eye, cataract immature, fundus seen fairly well, appears nomal,

except that the optic nerve is somewhat pale; V.=$^{6}/_{LX}$. Extraction with iridectomy and peripheral capsulotomy done under cocaine, 4% solution; by an error cocaine was used three or four times several hours before the operation; only one drop was instilled five minutes prior to the operation. When the cataract was removed, the cornea and eye generally was very flaccid, causing some difficulty about removing the lens completely; on account of this difficulty some lens substance was allowed to remain in the eye. Healing progressed favorably until the fourth day, when he managed to strike the covering of the eye with the hand and open the wound; a moderate reaction followed this injury.

Seventeen days after the operation the eye was quiet, and with +12 D. V.=$^{6}/_{LX}$, being greatly obstructed by a thick and wrinkled capsule containing some cortical substance. Capsulotomy done with one needle. Six days later all reaction had subsided, but there was only a small opening in the capsule, and very little improvement of vision. By the middle of December, that is six weeks after discission with 20°+2.00+ 11.00 V.=$^{6}/_{XII}$. For about one year he continued to enjoy pretty good vision, but in May, 1889, this was reduced to $^{6}/_{XXX}$ by a diminution of the capsular aperture. May 6, 1889, capsulotomy was again performed, this time with two needles, resulting in a good sized and nearly central aperture. This was followed by a sharp reaction for a few days. On June 11, 1889, vision was again $^{6}/_{XII}$ with his compound glasses. A few months later he noticed a gradual diminution in the acuteness of vision, and on October 30, $^{6}/_{XVIII}$ was the best he could do. At this time I could discover no positive cause for the failing vision; certainly it was not due to any fault in the capsular operation, the fundus was distinctly visible in detail, and showed no coarse changes, only a doubtful increase of tension was noticed, without cupping of the nerve or limitation of the visual field; the latter, however, was not then tested with as much care as the doubtful tension demanded.

There is nothing in the appearance of the eye suggestive of glaucoma. No iris in the wound and no adhesion of iris to

the dense capsule; under the edges of the pupil the capsule was thick and white, no doubt the result of an antecedent capsulitis, together with unabsorbed cortical remnants. For fifteen months longer, he continued to follow his employment (store house inspector, in a large railway company) without much difficulty, but on January 26, of this year, or three years and three months after the original operation, he came, on account of a recent and rather rapid failure of vision, which was now reduced to fingers at 6′. There has been no pain "only a blur or smoke has come over the sight." The sclerotic presents a slight glaucomotous injection. The cornea is faintly clouded. T. 2 and field contracted, on nasal side nearly to the center. Has not seen halos. The most, in fact, the only conspicuous abnormality about the eye is the condition of the capsule, which in addition to the thickened appearance, already mentioned, now bulges forward as a sail-like prominence in its upper part. The central aperture is clear and well defined as ever and the vitreous is free from opacity, so that a perfect view of the optic nerve is easily obtained. The nerve is pale and presents a moderately deep shelving cup, arterial pulsation is doubtful. The choroid is normal. On the same day I performed a large sclerotomy in a downward direction. No benefit came of the operation. Vision steadily diminished and on March 3 there remained only qual. p. l.

March 6, 1891. The left eye now presents a mature uncomplicated cataract, which I extracted with iridectomy, using Knapp's capsule forceps instead of the cystotome for opening the capsule. The wound united kindly and every-thing was entirely satisfactory until the fourth day; he then managed to strike this eye also through the bandage and re-open the wound. This remained open three or four days, but healed perfectly at last, without entangled iris or other visible complication. Three weeks after operation vision was tested, and with $180° + 3.00 + 9.00$ V$=^{6}/_{xx}$; a delicate looking shining capsule is stretched across the pupil, but without adhesion of the iris to any part of it.

At the end of four weeks he was out and at work, as usual,

although advised that the eye was not in a fit condition to be used. It looked and felt perfectly well. Before the end of April he was reading the evening papers at night, but outraged nature brought swift retribution. On May 2, he came with the statement that 4 days previously the sight suddenly became dim and the eye very painful. Fingers at 8 feet was all he could contrive to see. There was in addition T+2, steamy cornea and sluggish pupil, capsule thicker than when last seen, somewhat pushed forward and beset with minute dots, which appear dark when seen through a +20. D lens. Fundus seen very dimly, no details, no floating opacities in vitreous.

One drop of a 0.5% solution of eserine was now instilled and ordered to be repeated three times daily. Patient to remain quiet in a dim light. On the following day V=$^{6}/_{XXVII}$. The first drop took the pain away. To continue this treatment. May 9, V=$^{6}/_{XX}$ with correcting glass.

June 2. He has used eserine once or twice daily until yesterday. Can read and write with facility and has resumed work. Eye still a little hard, but there are no other signs of glaucoma. With 180°+1.25+12.00 $^{6}/_{18}$.

Advised to continue the eserine once every other day.

Sept. 20, 1891. Has had no further trouble with the left eye since June. The eye looks and feels perfectly well, tension is normal and in ordinary daylight V. Field is complete. He has used one drop of the eserine solution every other day and has worked comfortably all summer.

The capsule is thin and mostly clear; it is stretched straight across and not bulged and with a+20 D. lens, presents a series of bright folds pleated up to an irregular bright band at the upper part. The pupil is active and nowhere adherent. The optic nerve though pale is not cupped. The pallor of the nerve is of no special significance since it was observed several years previously, before the cataract had obscured the fundus. The right eye continues unaltered, blind but harmless. Tension remains distinctly increased.

In both patients the age, nationalty and physique was similar. In cases 1 and 2 a long interval of useful vision occurred

between the operation of extraction and the glaucomatous trouble. In both a dense capsule had been divided and the upper portion evidently rested in contact with the corresponding filtration region. This clinical observation, recorded in my note book, some years ago, has since been sustained by pathological investigation, as has been gathered from Mr. Collins' valuable paper, read before the Ophthalmological Society of Great Britain, in 1890, in which he describes that condition as an almost constant pathological state in eyes that have perished from glaucoma after extraction of a cataract. In none of my cases were there adhesions between the capsule and iris.

In all three, excessive use of the eyes seems to have been the important factor in the development of glaucoma. It is somewhat remarkable that both eyes of one patient became glaucomatous although not the slightest tendency to glaucoma existed prior to the removal of the cataract.

In the last case eserine has evidently had a curative effect, but in this case the glaucoma was more acute and in all probability depended on an early and injudicious use of the eye. The mechanical features of this case are totally different from the other two, and I am inclined to look upon the outbreak of glaucoma in this instance as an irritative condition brought on by over-exertion of the eye before its filtration apparatus had recovered from the disturbance which a wound in the immediate vicinity, but not to any extent through the canal of Schlemm, might readily create. The operation was, so far as I can judge, a typically perfect one, nor is there the least trace of injury or ill effect from the wound having been reopened a few days after its first closure. The capsule is, I think, certainly not in contact with the extraction scar, but then it is to be observed the eye has recovered without operation, showing that the cause of the glaucoma, whatever it may have been, was of a transient nature.

THE PRISMOMETRIC SCALE.

With Eleven Original Diagrams.

BY CHARLES F. PRENTICE, NEW YORK.

During the past two years "The Metric System of Numbering and Measuring Prisms"[1] has been a subject of considerable discussion, although the exact nature of its unit, the prism-dioptry, does not seem to have been generally understood, while its practical advantages to opticians, "of whom accurate work is expected," have been wholly disregarded in some recent criticisms, in which it has been compared with Dr. Jackson's and Dr. Dennet's equally as scientific though less *convenient* systems. It is, therefore, now proposed to call attention to a still more simple feature of the metric system, with further explanations, yet with the understanding that the reader is familiar with its general principle and applications as originally explained.

The prismometric scale, preferably drawn upon heavy paper or card board, consists of a line of gradations, "6 centimeters apart,"[2] which are indicated by heavy vertical lines, with an in-

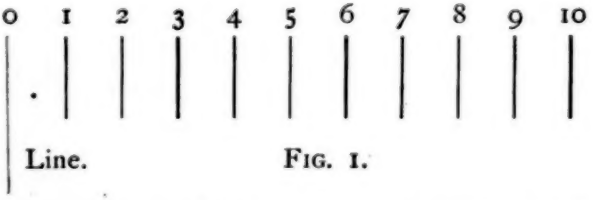

FIG. 1.

dex-line at zero, longer than the rest, as shown in Fig. 1, which

[1] A Metric System of Numbering and Measuring Prisms. By Chas. F. Prentice. Archives of Ophthalmology, Vol. xix, Nos. 1 and 2, 1890, and Vol. xx, No. 1, 1891.

[2] See Archives of Ophthalmology Vol. xix, No. 2, 1890.

being just six times greater than the "coarse centimeter scale" referred to in my first paper, is intended to be placed at a six times greater distance, or "6 meters" from the eye; when simple prisms may be measured by it according to the manner originally set forth.

The *average* deflections produced by our commercial prisms, marked 1° to 5°, will be found to correspond closely to this scale up to the fifth division.

In applying the scale to the measurement of sphero-prismatic lenses, it is evident that the index-line will be rendered more or less indistinct in viewing it through such a lens, so that the lenticular element of the sphero-prismatic lens will require to be fully neutralized by a *contra-generic* lens of the same power, when, by shifting the neutralizing lens from right to left, it will be possible to secure a position for it which will leave us the prismatic deflection which it is sought to attain by the inherent prism of the entire combination.

The procedure is best explained by the following example: The optician being requested to grind a sphero-prismatic lens of +3D. sph. ⌒2 prism-dioptries, selects from his stock a prism which is *rough* on one side, and which he consequently is obliged from its *marking*, to take for granted is a prism of 2°. He then grinds the rough side to +3D. spherical, when, according to the old method, he naturally assumes that he has accomplished the full object of his purpose. It is now suggested that he carefully determine the optical center of a *concave* lens of 3 dioptries, and mark this point with an ink dot, placing the opposite side of this neutralizing lens in contact with the spherical side of the sphero-prismatic lens which it is desired to measure. He is next requested to hold the entire combination before his eye, at exactly 6 metres from the scale, the precaution being taken to have the base-apex line of the sphero-prismatic lens horizontal, with the base to the left, and in such a manner that the upper edge of the entire combination covers only the lower half of the pupil. The index-line observed through the lenses will then appear to be displaced toward the right, relatively to the graduations as

seen through the uncovered upper portion of the pupil. In the event of the index-line appearing to be displaced more or less than the required graduation marked "2," the operator has only to shift the neutralizing lens carefully to the left or right, until the index line exactly cuts the second graduation. Care should be exercised not to change the position of the sphero-prismatic lens during this act, and while in this position, an ink dot should be placed on the sphero-prismatic lens, precisely opposite to the dot on the neutralizing lens. The former then indicates the point which should form the center of the glass in the spectacle frame.

The reasons for this will be obvious from a consideration of the following figures:

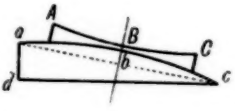

FIG. 2.

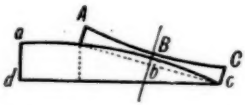

FIG. 3.

The concave lens A B C in Fig. 2, with its center at B, neutralizes the convex lens a b c, thus securing the *effect* of a prism a c d, *just at the opposite points* B b. By shifting the neutralizing lens, as shown in Fig. 3, the effect of a prism of greater angle is obtained. It is, consequently, possible, within reasonable limits, by this means to correct any inaccuracy which may have existed in the original *rough* prism. The same effect is obtained in sphero-cylindro-prismatic lenses, by neutralizing the cylindrical element with an additional and carefully adjusted *contra-generic* cylindrical lens, though this is naturally a little more difficult.

I shall preface a further discussion of this question with a few simple optical definitions, which I hold to be indispensable to a thorough understanding of the subject, and which, much to my regret, and for reasons too obvious to mention, were not presented by me in my previous papers in the *Archives of Ophthalmology*.

1. The optical center of a lens is a point situated upon a line called the *optical axis, which must be perpendicular to both the anterior and posterior surfaces of the lens.*

2. DIRECT PENCILS.—Rays of light which are emitted from a luminous point upon the optical axis will be refracted and directed to a conjugate point upon the same axis, it being specifically noted that the axes of the incident and refracted pencils of light and the optical axis of the lens *must* coincide.

3. OBLIQUE PENCILS.—In any case where the axis of the incident cone of light does not coincide with the normals to the surfaces of the refracting medium, whether it be a lens, prism or plate, the refracted pencil will no longer be a circular cone of light; but it will be a pencil bounded by a surface penetrating the medium and defining its illuminated area, besides intersecting two focal lines, which are at right angles to each other and the axis of the refracted pencil.

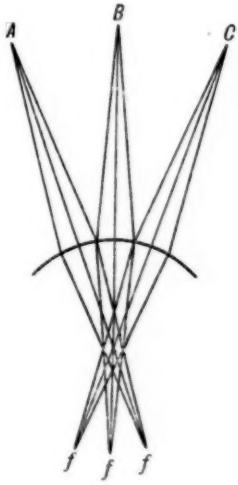

FIG. 4.

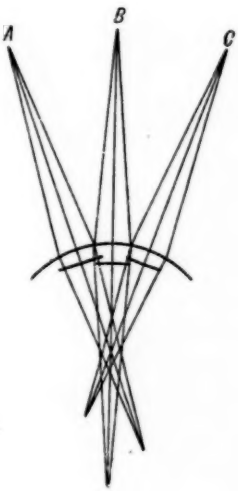

FIG. 5.

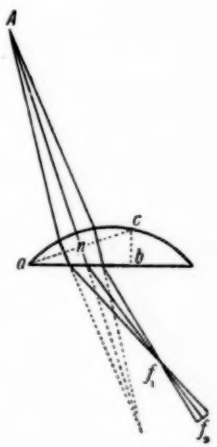

FIG. 6.

The same laws apply to the *reflection by spherical surfaces* of direct and oblique incident pencils of light, and their mathe-

matical elucidation is given by Profs. R. S. Heath and W. Steadman Aldis, in their recent exhaustive treatises on Geometrical Optics.

In illustration of the above definitions, let the curved line in fig. 4 represent the spherical surface of a medium with a greater density than air, when perpendicularly incident conical pencils of light, projected upon it from successive points A, B, C, will have their respective conjugate foci, f, upon the correlative radii with which the axes of the incident pencils coincide. If the refracted pencils, *within* the medium, are to have *focal points outside* of the medium, the axes of these pencils will have to be *perpendicularly* intercepted by the second surfaces as shown by the heavy lines in fig. 5; and in the event of the second surface occupying an oblique position, a b, fig. 6, with respect to the pencil A, the medium must be considered as a lens, having its optical centre upon the axis An of the incident pencil, with the prism a b c added to it.

The circular cone of light, *within* the medium, will then project an elliptical area of illumination, E, fig. 7, upon the second surface, as the axis of the pencil is here *oblique*, and the refracted pencil ceases to be a circular cone, projecting itself outside of the medium as an *astigmatic* pencil, of which f_1 and f_2 are the focal lines at right angles to the axis, the whole being deflected toward the base of the inherent prism P.

While this optical phenomenon, which in this case we may term a sphero-cylindro-prismatic action, may be new to many, it has been known to physical science since Kummer, in 1860, first called attention to the theory by which it was mathematically demonstrated. Its significance to ophthalmological science may, perhaps, be treated of in the future.

The fact, however, may be experimentally, though roughly, demonstrated by placing a plano-convex lens of 8 dioptries directly between a light at 10 or even 20 feet, and a screen receiving its image. On interposing a prism of 20°, for example, with its base down, and in a manner to insure contact of the plane faces of the glasses, the image will be observed to change both its form and position upon the screen. By draw-

ing the screen slightly nearer to the lens, a horizontal though imperfectly defined line corresponding to f_1 will become manifest, and by increasing the distance between lens and screen a vertically elongated looped figure, closely resembling a line at f_2, will appear.

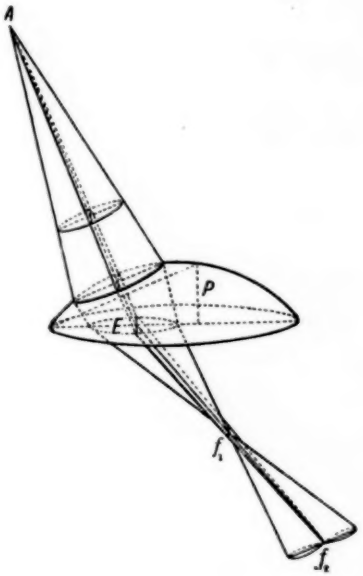

FIG. 7.

When a circular cone of light, C, fig. 8, from a short finite distance falls *obliquely* upon the face of a simple prism, we again have an elliptical area of illumination, and the refracted rays *within* the medium will assume a direction as if emitted from the focal lines v_1, v_2, reaching the second surface of the prism, and being refracted by it to the eye at E, as if projected from the lines V_1, V_2, on the opposite side of the prism.

There is one exception to this result, and that is when the axis of the incident pencil assumes a direction which is subject to minimum deviation, in which event the emergent pencil will appear to diverge from a *point*, at the same distance

from the anterior surface as the original source of light C. In the case of a plate, the emergent pencil will also be of astigmatic form, with the difference that it will appear to proceed from a pair of focal lines located upon an axis *parallel* to the axis of the incident pencil.

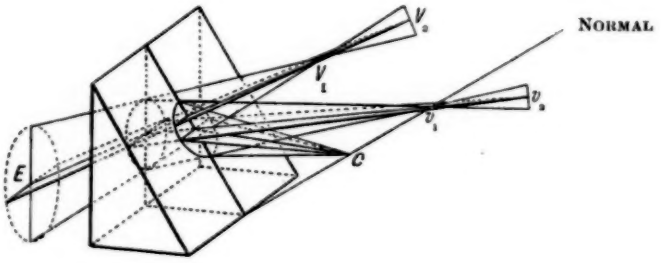

FIG. 8.

This sphero-cylindro-prismatic action, on the part of a simple prism may be experimentally demonstrated in the following manner. Having constructed the figure M O (to the left in fig. 9) in which the width of the principal lines is say 2 inches, and the distance apart of the perpendiculars is about 24 inches,

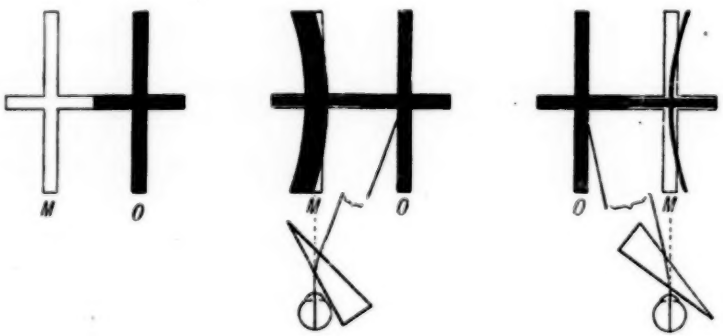

FIG. 9.

place it at right angles to the line of sight, at a distance of about 6 feet from the eye, before which a prism of 10° is given

considerable inclination to the visual axis, with its base in or out, and as shown in the diagrams, fig. 9, which should suffice to indicate both methods and their results. The eye in each instance is to be placed directly opposite to the figure M. With these facts in mind we may return to our subject of measurement.

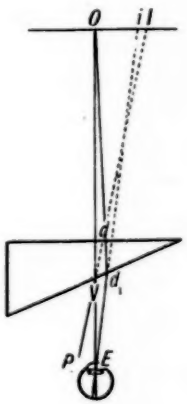

FIG. 10.

In fig. 10 the relative positions of the object of fixation O, the prism, and the eye are shown. It is evident that the perpendicularly incident axis O V of the conical pencil of rays emitted by the object O coincides with the visual axis, and that the axis of the refracted pencil V P *does not* enter the eye, although it *does* define the deflection O I which it is desired to ascertain. The axis of the refracted pencil, d_1 E, which *does* enter the eye, however, will result from that incident pencil whose axis is *oblique* relatively to the normal at d, and it will therefore be a ray approaching direction for minimum deviation and will consequently suffer less refraction than the refracted pencil whose axis is V P.

Now if, as is the case with the prismometer, the observer reads the deflection O i at the finite distance marked, say "10", upon the graduated bar, it is evident that an error will be com-

mitted, since 10 times O i will be less than 10 times O I[3]; yet this seeming weakness in my previous papers has escaped detection by the critics of the prism-dioptry system, and for the consolation of whom let it now be said that there could have been no reasoning so clever or ingenious on their part as to have made this error any the less apparent, *even in a prism of 10°*, by merely contrasting the differences between arcs, sines and tangents, in a choice for the unit of measurement; besides, a mere consideration of the well known relative goniometrical values of these has not hitherto been pertinent to the discussion, since the proposed unit, the prism-dioptry, is not a goniometrical unit, but an *optical unit.* The desire to multiply any *unit in optics* should be curbed by a knowledge of the fact that all the fundamental optical laws are based upon the assumption and acceptance of *values of limited magnitude*, and that there is therefore apt to be a point where *unreasonable* multiplication of an optical unit will contradict the actually existing optical phenomenon. *A warning to this effect was given in speaking of the decentration of lenses* (see page 129 of my second paper).

Even *thickness*, a dimension which we are taught to neglect with respect to ophthalmic lenses, becomes an appreciable factor in prisms above 10°, when we attempt to measure their deflection at short finite distance. This will be apparent from the following considerations.

It has been shown that the ray, which in the nearest limit reaches the eye, is the axis O d, fig. 11, of an *oblique* pencil, being refracted within the prism A B C from d to d_1, and thence in air to the eye E, which projects it to i, upon the scale O I. For a given thickness of prism, this is the *only* pencil which will be received by the eye, since, if we increase the thickness by allowing the plane $A_1 B_1$ to represent the anterior surface of the prism, the original incident axis O d will be refracted at v instead of d, when the axis of the refracted pencil will traverse

[3]This will be equally true for measurements taken from an arc at short finite distance.

the path $vv_1 P_1$ to the left of and parallel to $dd_1 E$. The refracted pencil which would enter the eye, for the indicated *increased* thickness, could only accrue from an *increased* obliquity of the incident axis Ou. The latter would therefore even more closely approach position for minimum deviation, from which we are to conclude that the deflection noted upon the scale OI by the eye will be *least near the base* and consequently greatest near the apex of the prism.

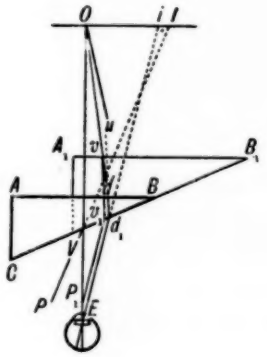

FIG. 11.

This is really proven to be the case by experiment with the prismometer. At the distance marked "10" upon the bar, the index-plate-reading near the base of a 22° prism, $1^1/_4$ inches square, is found to be 1.79, whereas at the feather-edged apex it is 1.89, so that the prism in the former instances measures 17.9 P D, while in the latter it is 18.9 P D. The same prism measured by the prismometric scale at 6 meters reads 20 P D. The error committed by measurement through the apex, at short finite distance, is therefor 1.1 P D, while the increased thickness at the base still further increases the error by 1 P D. The error will consequently be least, *in prisms of high degree*, when readings on the prismometer are taken at the apex of the prism, and it will be reduced to a minimum, *throughout the principal refracting plane*, when the deflection is measured for

pencils which are *perpendicularly incident to all points of the prism-surface*, that is to say, when the pencils of light are *cylindrical*, and which will practically be the case when the object of fixation, *a line*, is situated at 6 meters distance. In fact it will be better to measure all prisms above 10° at this distance.

This sharply defines both Dr. Burnett's and my own reason for advocating the tangent plane for the position of the scale, since it will be infinitely more *convenient* to place such a scale upon a flat wall, with which every office and workshop is provided, than to *contrive* an arc of 6 meters radius.

Other advantages of the scale at a 6 meter distance were mentioned in my second paper, when referring to hyperphoria.

The above facts do not lessen the value of the prismometer, which I have repeatedly and specifically represented as being of importance to opticians in filling oculists' prescriptions, in which the prisms do not exceed 5°, and by reason of which the error is so slight as to be inappreciable, yea, even in a prism as high as 8°, when an attempt is made to verify measurement by the prismometric scale at 6 meters.

It was also to be supposed that all oculists and opticians would not provide themselves with prismometers, in which event it was further anticipated that the prismometric scale would have to be resorted to, and more particularly now that hair-splitting fractions of the unit are not considered to be of value.

A more simple and convenient means of verifying the opticians' work could not be placed in the hands of the oculist.

The prism dioptry does not exclusively depend upon trigonometrical laws, nor rest solely upon the adoption of a specific instrument, but it is based upon a principle which is easily understood and capable of being practically applied within the confining limits set by the fundamental laws of optical science; and it must further be apparent that the generally irrelevant criticisms which have appeared in print have not, thus far, proven anything to the contrary; while it must be equally

clear that this paper contains a review of the optical laws and phenomena which must be considered in the choice of a unit, and that these will require to be thoroughly understood, before anyone can undertake a rational criticism of the subject. However, it is admitted that a perpetuance of the present degree system, together with the commonly accepted approximations which must accompany its application in practice, will obviate such pains being taken.

TWO CASES OF SUCCESSFUL SKIN-GRAFTING UPON THE EYELID, BY THIERSCH'S METHOD.[1]

BY SAMUEL THEOBALD, M.D.,

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Having had the opportunity of observing in the surgical wards of the Johns Hopkins Hospital the very happy results which have been obtained there from the adoption of the method of skin grafting proposed by Thiersch, I was prepared to resort to it with confidence should a suitable case occur in my ophthalmic practice. Two such cases have occurred during the past year, and the result in each has shown that my confidence was not misplaced. The successful outcome of these cases is the more noteworthy in view of the fact that they were both treated as out-patients, one at my office, and the other at the dispensary of the Baltimore Eye, Ear and Throat Charity Hospital, and that the antiseptic precautions employed in each were far from perfect. In both, the grafts were removed with a small slender scalpel, from the inside of the forearm, the skin from which they were taken having been washed first with soap and water, then with sublimate solution and lastly with a solution of common salt.

While the wound was being prepared for their reception, the grafts were placed in a warm, unsterilized solution of salt, the strength of which was not accurately gauged. They were somewhat less than half an inch in width and of varying

[1]A paper read before the American Ophthalmological Society, at its recent meeting in Washington, in connection with the Congress of American Physicians and Surgeons.

lengths, some of the longer strips having been cut in pieces in order to make them fit more accurately the spaces upon which they were grafted. No antiseptic was applied to the wounds upon which the grafts were placed. Their granulating surfaces were in part shaved off (as recommended by Dr. Halstead) and in part scraped, and the bleeding surface which was thus produced was wiped off with non-sterilized absorbent cotton; dipped in the warm salt solution. After the grafts were in position, they were covered with "rubber protective," which, except in one instance, had not been sterilized, and over this was placed lint or absorbent cotton and a retaining bandage.

In one of the cases, that of a laboring man, about 25 years of age, the wound which made the grafting necessary, and which involved, besides other portions of the face, nearly the whole of the upper lid, the brow and the temple upon the right side, was the result of a burn by sulphuric acid, which had been purposely thrown into the individual's face. The first grafts, three in number, were made sixteen days after the receipt of the injury. Three days afterwards three more were made, and two days later five more. All of the grafts "took" well with one exception, and a portion even of this one lived and grew.

They were applied over nearly the whole of the upper lid, upon and above the brow, and upon the temple in the neighborhood of the outer canthus. One week after the last grafts were applied the notes of the case state "there is no surface on or near the lid which is not covered by epidermis." Five months have now elapsed since the injury occurred, and the outcome of the treatment is, that while the lid is considerably shortened, and near the outer canthus does not lie in complete contact with the eyeball, it is not everted at any point and closes well over the cornea. Massage is being practised upon the lid, and I have not been able to detect any increase in the shortening or in the tendency to erosion during the last three months. Had the skin grafting not been resorted to in this

case, there is, I think, little doubt that a marked ectropion would have developed before this time.

In the other case, the wound which called for the application of the grafts was due to the removal of an epithelioma from the lower eyelid. The patient was a railroad watchman, and about 50 years of age. The growth was removed with a sharp curette, supplemented by the application of the thermocautery. Five days later the charred tissue was removed, the granulations were scraped, and three small grafts were applied. The "protective" used in this instance had been thoroughly sterilized. Two days later the protective was removed and it was found that two of the grafts, and a part of the third one, were living. The death of a part of one of the grafts appeared to be due to the fact that the charred tissue had not been thoroughly removed from the whole of the surface upon which it was placed. The protective was re-applied, and worn for three days longer, when, as the grafts had united firmly, it was left off permanently. The patient was seen but once after this, and the ultimate effect of the treatment is not known. I have recently tried to communicate with him, but I regret to say, without success.

FOUR CASES OF REFLEX AMBLYOPIA.

JOHN DUNN, M.D., RICHMOND, VA.

Of the following four cases the first two have been reported at length, and are mentioned here only because they complete the picture showing that amblyopia may result reflexly from irritation of any of the three branches of the 5th nerve.

I. Mr. C., struck in the right eye with a snowball, injuring the supra-orbital nerve. More or less trouble began immediately with his eye, which troubles gradually increased until, $3^1/_2$ years later, the following symptoms presented themselves. Amblyopia, V. O.D.$=^9/_{CC}$, V. O.S.$=^{18}/_{C}$. Amplitude of accommodation for Jaeger's 2 was 2 cm. Concentric contraction of both fields of vision, greater for O.D.; clonic spasm of the accommodation. Amblyopia not due to this, however, as use of atropine and correcting glasses did not improve vision. Eye extremely sensitive to light and painful in cold weather. Presence of a cloud, whose density varied from time to time, before both eyes. Hyperæmic condition of conjunctiva. No changes in the fundus—clonic spasms of the inferior palpebral fibres of the orbicularis. Subcutaneous section of the right supra-orbital; one month later every symptom of reflex trouble had disappeared. V. O.D. and O. S. $^{18}/_{XV}$.

II. Patient struck with a stone over left supra-orbital nerve. Identical with I, except that the symptoms had existed only four months when the patient was seen. V. O.D.$=^{18}/_{XL}$, O.S. $=^{18}/_{L}$. Concentric contraction of fields, etc. Same further history, with restoration at the time of V. to normal by section of the supra-orbital nerve.

III. Mr. B., æt. 18; complained that he was unable to read without pain to his eyes, especially the left. Examination

showed complete paralysis of left facial nerve, which had been of some weeks' standing. Inability to close the left eye; characteristic want of symmetry of the two sides of the mouth, which is drawn to the right; inability to whistle; some change in speech, etc., etc. Patient could make out with O. S. some of the letters in $^{18}/_{XX}$; with O.D. some of the letters in $^{18}/_{XV}$. This could not be improved with the use of proper glasses, even when pupils were dilated with atropine. Field of vision for O.S. was slightly, but certainly, contracted. No diminution for the field of O.D. could be shown with the perimeter, yet it is highly probable that it was keeping pace with the loss of vision (Patients with full vision read $^{18}/_{15}$ Snellen perfectly, and most of them $^{18}/_{10}$). The pain caused by attempts to read, although the patient was somewhat hyperopic, was probably due to reflex interference with the ciliary muscle. Examination revealed as probable cause of the paralysis an abscess at the root of second molar of inferior maxilla of the left side. This tooth was drawn, when, after a few days under treatment, the paralysis disappeared and with it the ocular symptoms. Vision became full for both eyes.

IV. Mr. P., æt. 59; on June 6, 1891, fell against the footboard of his bed and struck his right cheek just below the lower margin of the orbit. The pain was severe at the time; the right side of his face became so swollen that his right eye was closed, and on the following day he was unable to open his mouth (probably due to contraction of the muscles of mastication). He could not feel his hand when he rubbed it against the right side of his nose. The right half of his upper lip became insensitive, so that it was no longer painful to pull the hairs of his moustache on this side. His nose became stopped up so that he could not breathe through it (sensation due to the insensitive condition of the nasal mucous membrane of this side). The inability to open his mouth continued to such a degree that for two or three weeks he was compelled to subsist on milk, which he sucked into his mouth from bread soaked in this fluid. The teeth on the right side began to ache and finally ulcerations began in the gums. When I saw

the patient first, on July 22, the mucous membrane of the gums and of part of the right side of the upper jaw and adjacent mucous membrane of the cheek are nearly insensitive, *i. e.*, the pain produced by forcing the point of a knife into it was very slight as compared with the pain produced by same procedure on other side of mouth. Attempts to separate the teeth for more than half an inch are very painful. In pulling back the upper lip it was found that the upper lateral incisor and bicuspid of the right side were absent, and the adjacent gum was healthy; the canine tooth and second bicuspid were present, and the mucous membrane above each was in an ulcerated condition. The patient complained especially about loss of eyesight since the receipt of the blow. There was slight ptosis of the right upper eyelid, but not enough to interfere with vision. There were also slight clonic contractions of the inferior palpebral fibres of the orbicularis, a constant reflex symptom in Cases I. and II. I was unable to make out contraction of the fields of vision, though I am not certain that the patient understood what was to be done by him when before the perimeter. Unfortunately this patient belonged to the uncertainties of a clinic, and I was unable to follow the history of the case. One point, however, interests us in it, the injury to the intra-orbital nerves, followed by complaints of impairment of vision. There was no visible trouble of the fundus or media.

The four cases show that injury to any of the three branches of the 5th nerve may give rise reflexly to amblyopia. The first two cases show the amblyopia resulting from injury to the supra-orbital branch of the ophthalmic; Case II, to injury of the terminal branches of the superior maxillary; Case III, to inferior dental branch of the inferior maxillary. The amblyopia, that is, the diminution of the visual acuity, reflex upon injury or irritation (especially the latter) of some branch of the 5th nerve, has with it, it would seem, a host of companions whose presence serve to separate this form of amblyopia from those due to other causes. From examination of the above cases we find that the diminution in vision is accompanied by

diminution in the fields of vision; diminution in the amplitude of accommodation (due to ciliary spasm, clonic); diminution of the light-resisting power of the eye; hyperæmic condition of the conjunctiva; slight clonic contractions of the inferior palpebral fibres of the orbicularis in all cases except No. III, where there was complete paralysis of the facial; presence of a cloud before the eyes in Cases I and II; slight ptosis in Case IV. The intensity of all the symptoms varies from time to time, with a general tendency to increase as long as the cause of the irritation remains. The amblyopia and its accompanying symptoms are severest in the eye of the side upon which the irritation to the nerve exists; but if the irritation continue tor a sufficiently long time both eyes become affected, the first eye showing the symptoms to a greater degree.

In none of the above cases, although one of them had existed for three and a half years, did any nutritive trouble of the eye, such as corneal ulcer, etc., supervene. The fundus remains normal. There seems to be good reason to believe that the prognosis in these cases is good where the cause of the trouble can be removed; that is, that the results of the continuous excessive energy on the part of the eye nerves, called forth by a persistent focus of irritation in some branch of the 5th nerve, are not permanent after the focus of irritation has been removed.

A CASE OF CHOKED DISKS WITH UNIMPAIRED VISION.

BY DAVID WEBSTER, M.D.,

Professor of Ophthalmology in the New York Polyclinic, and in Dartmouth Medical College, Hanover, N. H.; Surgeon to the Manhattan Eye and Ear Hospital.

Rev. Z. D., æt. 36, consulted Dr. C. R. Agnew in the spring of 1873 on account of asthenopia. Dr. Agnew found that he had simple myopic astigmatism, and ordered glasses for him: right eye, $-{}^{1}/_{42}$ cyl.; left eye, $-{}^{1}/_{48}$ cyl., which gave him vision $={}^{20}/_{XX}$ in each eye. Mr. Z. did not appear again at our office until August 22, 1879, when he gave the following history: He has not used the glasses for the last two years because he has not seemed to need them. He had been preaching since last January in North Carolina. For the last four years he has been troubled with malaria which he got in New Jersey. Two and a half months ago he went out, on an intensely hot day, and walked in the sun without an umbrella, for some time. That night he was attacked with a "bloated feeling" in his stomach as though fermentation were going on in that organ. The next morning, Sunday, he could eat no breakfast. He attempted to hold service, but fainted when about half through. The following Tuesday or Wednesday he began to have severe headache, and in ten days he went to Blue Ridge Mountains. He was taken sick as soon as he got there and was confined to his bed for twenty days with "neuralgic" headaches. He was delirious part of the time, and his physician said that his headache proceeded from enlargement of the liver. About three weeks ago he began to have confusion of vision, double sight, and dizziness. A week later he saw Dr. Leaming who prescribed muriate of ammonia for his

head symptoms, which he is still taking with some benefit. His urine was examined in the Mountains, and was found to contain a little bile, but nothing else abnormal. He had frequent attacks of vomiting in the Mountains, but none since he came to New York. He still has severe and constant headaches.

Right eye, V.=$^{20}/_{XX}$ with + $^{1}/_{48}$ s. ⌒ + $^{1}/_{48}$ c. axis 90°.

Left eye, V.=$^{20}/_{XX}$ with + $^{1}/_{60}$ s. ⌒ + $^{1}/_{60}$ c. axis 90°.

Paresis of left external rectus. On thrusting tongue out it deviates to the right. For the last three or four weeks he has had a throbbing in his ears corresponding to his heart-beats—a sort of pulsating tinnitus. Hearing: Right ear=$^{120}/_{60}$; Left ear=$^{60}/_{60}$. Inspection shows nothing abnormal in either case. The patient says he never had venereal disease.

Ophthalmoscopic examination shows "choked disks." Disks swollen $^{1}/_{16}$ each. Retinal vessels buried in spots by exudation in immediate vicinity of disks. A few minute blood-extravasations on discal borders.

Dr. Agnew ordered two leeches to each temple, smoke coquilles, bromide of potassium for his headaches.

August 25. Dr. Agnew thinks it must be a case of intracranial tumor. Ordered mercurial inunction.

The patient remembers that a year and a half ago he was attacked during service, without known cause, with a severe headache across the top of his head, and he became almost unconscious. The attack lasted five hours and passed off gradually.

He had two less severe attacks four and eight days previously. His physician ascribed these attacks to malaria.

August 26. The headache is less severe.

Right eye, V.=$^{20}/_{XX}$ with + $^{1}/_{60}$ s. ⌒ + $^{1}/_{60}$ c. axis 90°.

Left eye, V.=$^{20}/_{XX}$; no glass accepted.

August 29. The patient remembers that about fifteen months ago he was thrown from a buggy and drawn along about twenty feet, the hind wheel of the buggy resting on his left side. He drove home, however, after the buggy was

righted, but had to stay in bed for three days on account of muscular soreness.

His urine, examined by Dr. E. A. Maxwell, showed:

1. Narrow hyaline casts.
2. Narrow hyaline, finely granular casts containing one or two cells of tubular epithelium.
3. Tubular epithelium, free.
4. Oxalate of lime.
5. No albumen or sugar.

August 30. The patient went to see Dr. Leaming this morning, and on his return, suffered severely for an hour and a half with cramps in the stomach, vomiting and headache. In the afternoon he had a similar attack lasting three hours. At 10 o'clock P. M. I gave him hypodermically, Majendie's solution of morphia, ♏ x. He vomited soon after.

August 31. Was made comfortable by the morphia, but did not sleep till 5 o'clock A. M. when he dozed off for an hour or two. Stopped the mercurial inunction. Dr. Leaming gave him calomel grs. xxx yesterday, and also prescribed a sweat. His mouth is "touched."

September 1. Drs. Agnew and Leaming met in consultation and put him on a milk diet.

September 9. The patient was put upon iodide of potassium, a saturated solution, 10 minims three times a day, and to increase the dose 5 minims daily.

September 14. He is taking 45 minims of the solution of iodide of potassium three times a day.

This morning at 8 o'clock, while lying quietly on his back, he felt as if something burst or broke in his left side in the region of the kidney. The most agonizing pain set in at once. He took two doses of elixir of opium, 20 drops each. I saw him at 9:20 when, the pain being unabated, I gave him hypodermically, 10 minims of Magendie's solution of morphia, and ordered hot fomentations to his abdomen.

Dr. John G. Curtis was called in consultation and suggested that the pain was caused by the passage of a renal calculus. I saw him again at 12 o'clock, when the pain being more intense

than before and having extended over the region of the bladder I gave him another hypodermic injection of morphine and applied a large mustard poultice over the whole painful region. At 2 o'clock P. M. the patient was easier.

September 15. Dr. Agnew saw the patient, and as the pain was still very severe, he ordered chloral hydrate grs. v, to be taken with McMunn's elixir of opium, ♏ xv.

September 16. The patient took two doses of the above and vomited half an hour after he took the second dose, and the pain was not relieved. He suffered very severely with pain, all through the lower part of the abdomen from 10 P. M. to 2:30 A. M., when I was called and gave him 10 minims of Magendie by the skin. This blunted the pain and quieted him. At 1 P. M. I gave him 10 minims of Magendie and the same at 5 P. M., after consultation with Dr. Austin Flint, who inclined to the opinion that he has "granular contracted kidney," renal calculus, and basilar meningitis. Dr. Flint advised to administer opiates sufficient to relieve the pain and to sustain the patient entirely by fluids.

Dr. Maxwell examined another specimen of his urine at this date and found:

1. Narrow and medium hyaline casts, from two to six on a slide.
2. Tubular epithelium, scanty.
3. No albumen.
4. Oxalate of lime.

At 10:30 o'clock I gave him another hypodermic of 10 minims of Majendie.

September 17. The patient has had no pain since I left him last night and has slept soundly. He is considerably under the influence of opium, but is easily roused.

September 18. Ordered acid. nitro-muriatic. dil. minims vij, t. i. d.

September 25. Right eye, V.=$^{20}/_{xx}$ with + $^{1}/_{60}$ c. axis 90°.
Left eye, V.=$^{20}/_{xx}$; no glass accepted.

He has diplopia on looking far to the left. Insufficiency of external rectus 4° at 20′.

Ophthalmoscopic examination shows the optic papilla hypermetropic $^{1}/_{24}$ in each eye. There are no retinal hæmorrhages or exudations remaining, but simply a diminished swelling of the optic discs.

The subsequent history of the case was given me by his widow some years later. About two months after the above note was made the patient consulted Dr. T. E. Satterthwaite, who was inclined to think him a hypochondriac. He then drifted into the hands of an advertising charlatan who treated him with electricity. The first application made him unconscious for about an hour, the second less than an hour, the third still less, and the fourth had no unpleasant effects. He considered himself benefited by this galvanic treatment. He died in March, 1887, while under the care of a homœopathic physician, Dr. Clark, of Harlem. He is said to have died of "uræmic poisoning thought to be caused by cancer of the liver," but there was no autopsy.

Mrs. Z. D. stated that her husband's eyesight was perfect, with his glasses, so far as he could judge, as long as he lived. Whether more or less optic neuritis remained throughout his life, or whether the papillitis was eventually replaced by apparent atrophy, no one will ever know.

CORRESPONDENCE.

CORRECTION.

MACON, GA., October 24, 1891.

EDITOR AMERICAN JOURNAL OF OPHTHALMOLOGY.—In the September number of THE AMERICAN JOURNAL OF OPHTHALMOLOGY, in my remarks upon Homatropine, page 311, 3d line from bottom, there is a misprint. It reads *marked* astigmatism. It should read *masked* astigmatism.

R. O. COTTER, M.D.